



# **Gas Supersaturation May Reduce the Survival of Yearling Chinook Salmon in the Lower Columbia River and Ocean Plume**

**Ian Brosnan, NASA Ames Research Center**

**David Welch, Kintama Research Services**

**Melinda Jacobs Scott, formerly Kintama Research Services**

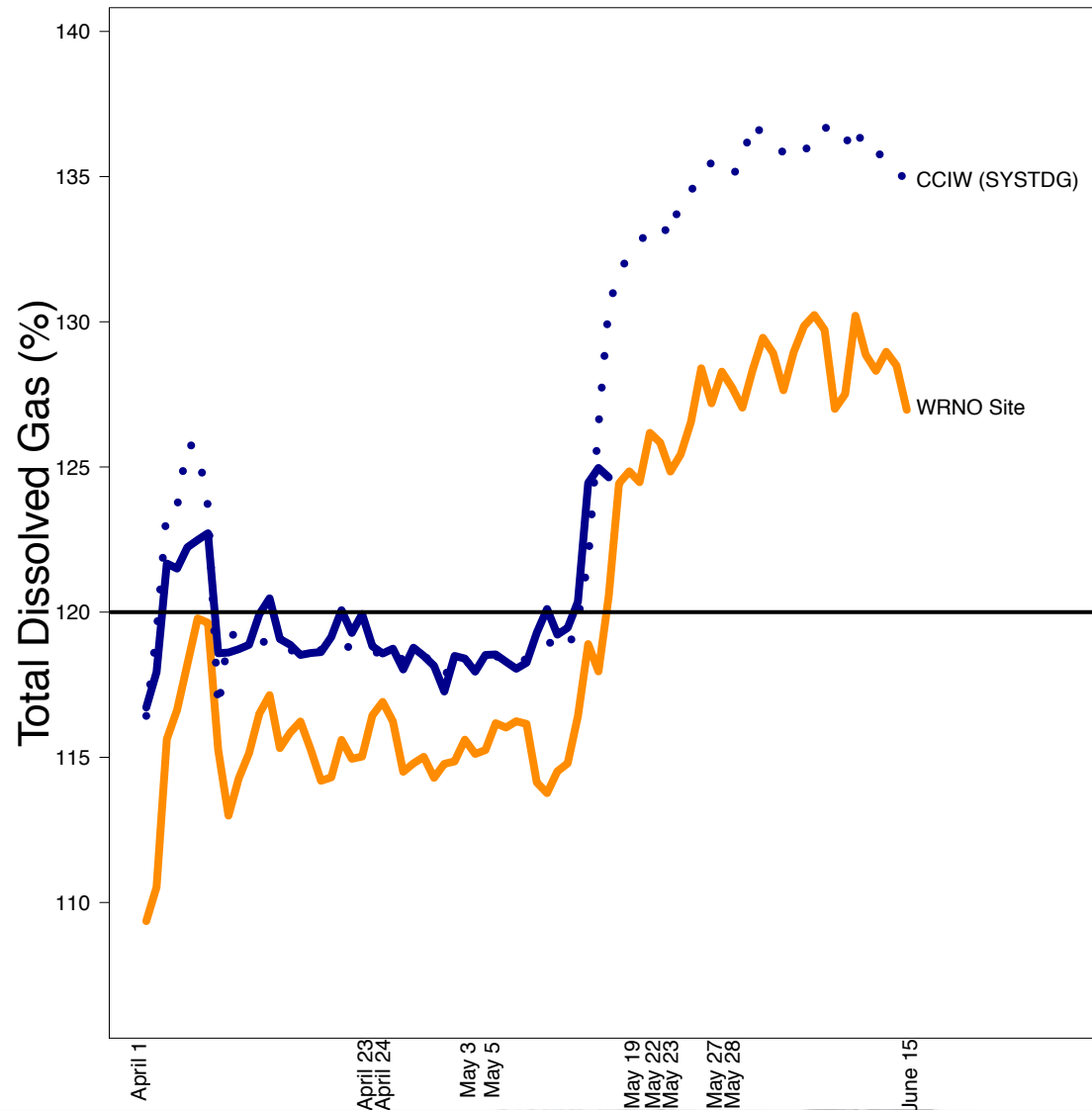
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**American Fisheries Society 145<sup>th</sup> Annual Meeting, Portland, Oregon**

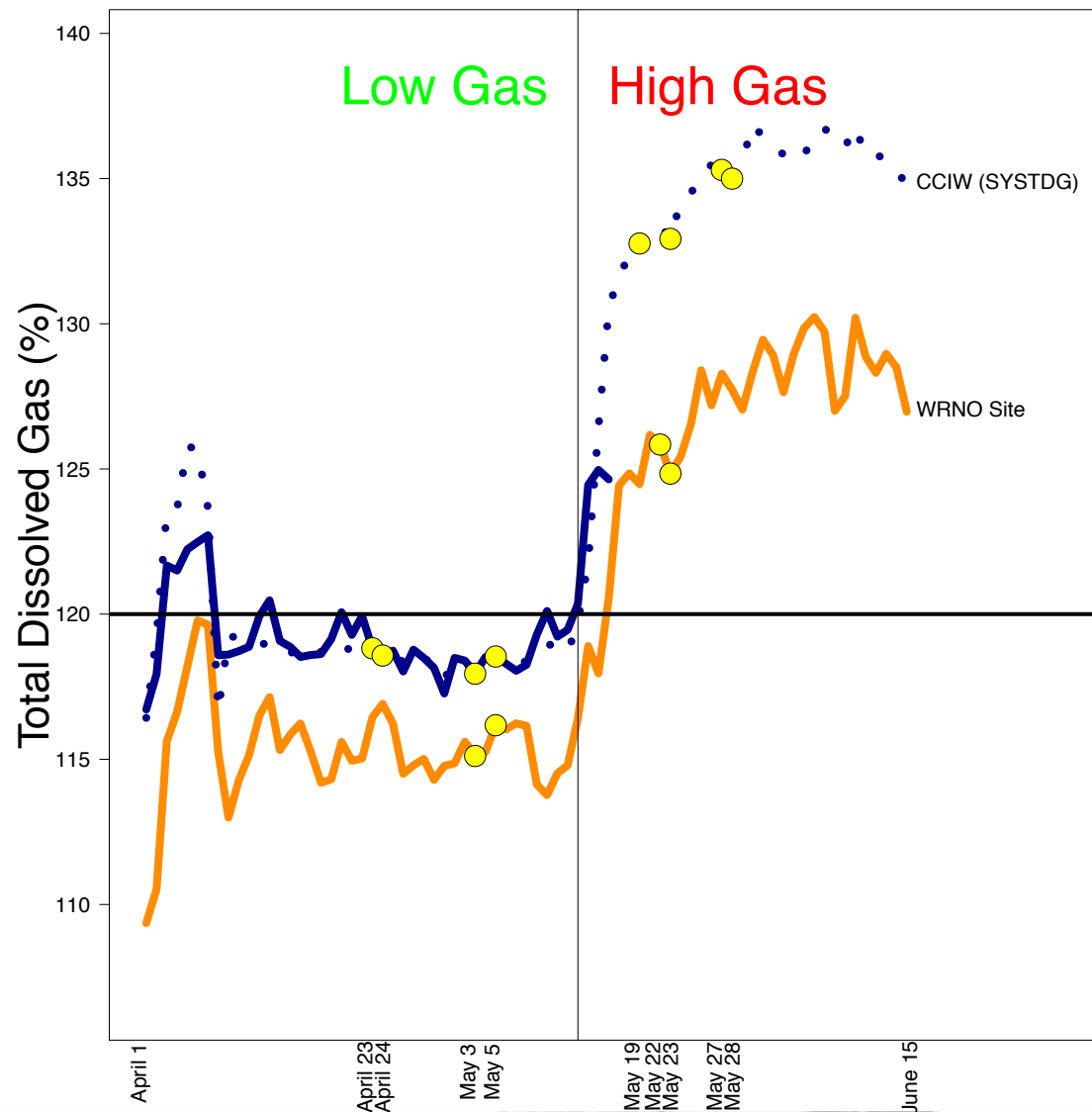
**August 18<sup>th</sup>, 2015**



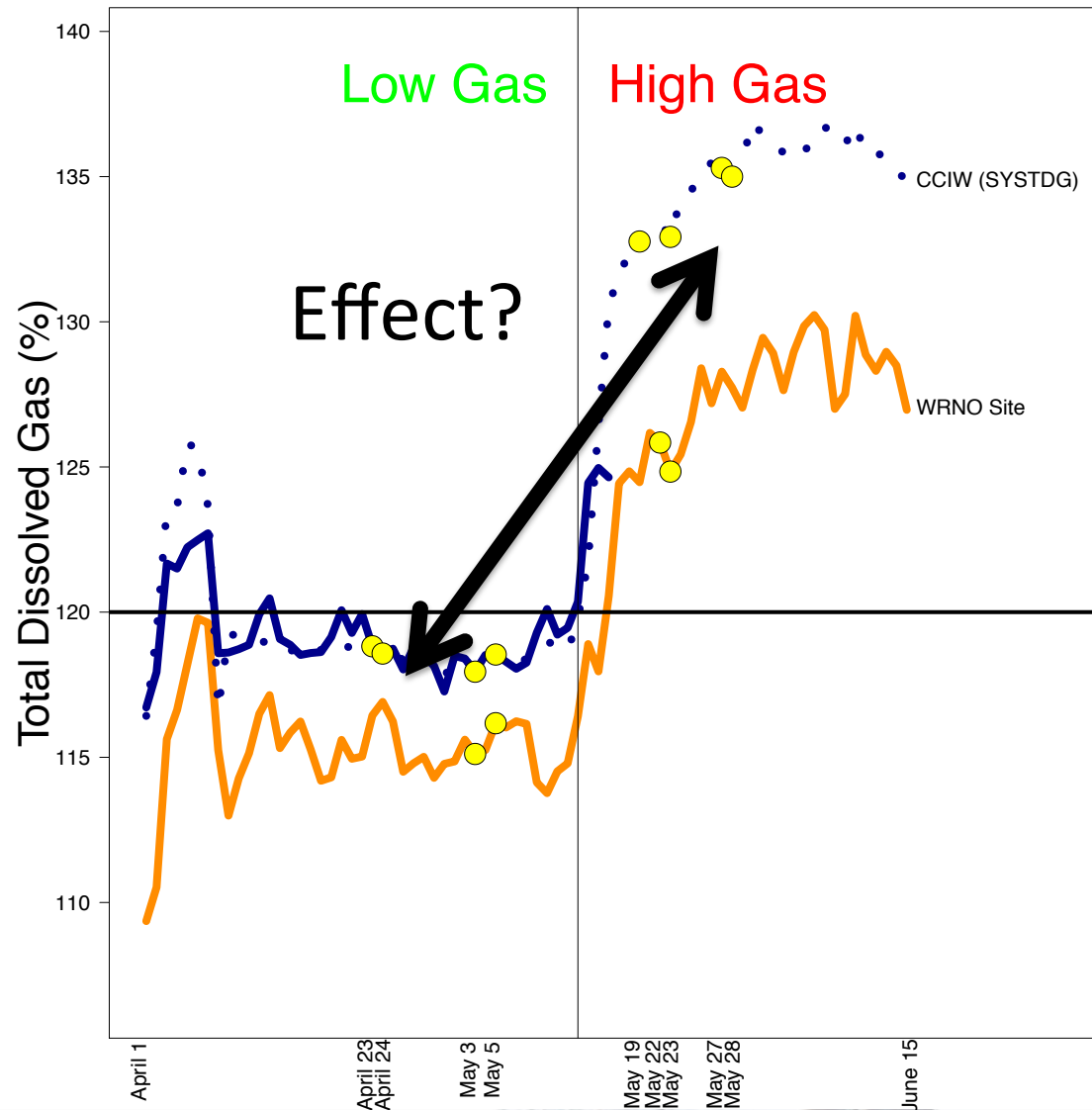
# 2011 TDG below Bonneville Dam



# What effect on smolts?



# What effect on smolts?





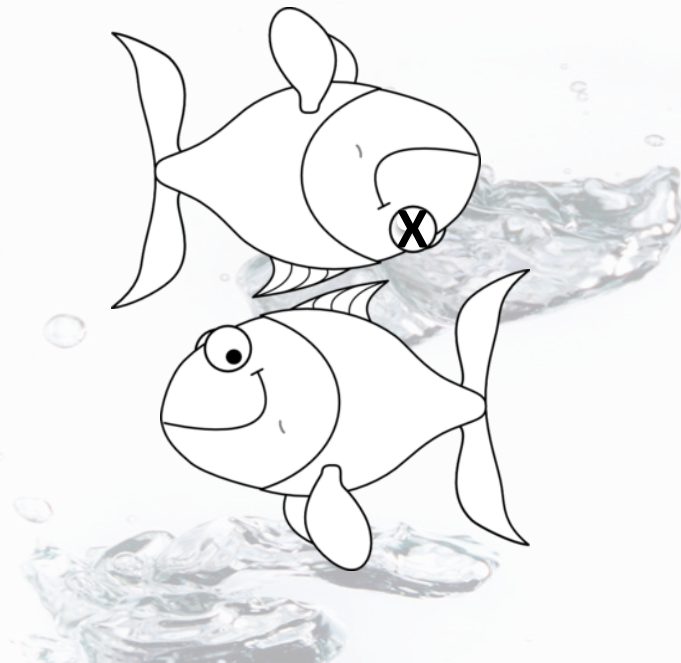
## Gas Bubble Trauma (GBT)

130 % TDG: GBT,  $LT_{20}$  at 3-6hrs, predation

120 % TDG: GBT,  $LT_{20}$  at 40-120 hrs


110 % TDG: GBT, No mortality at 22 d

Repeated exposure increases susceptibility



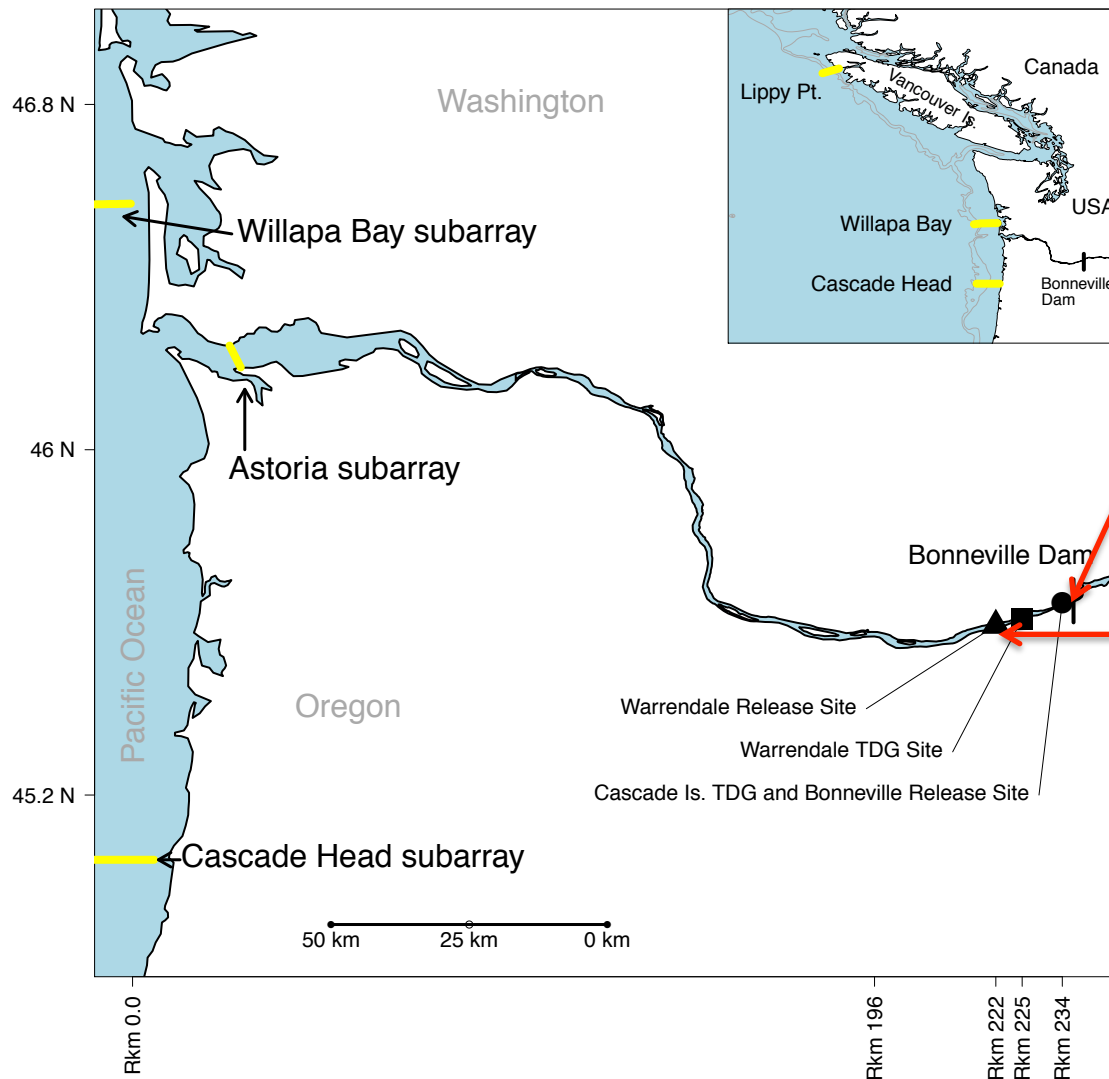






Tagged smolts screened for  
scale loss, external marks,  
lesions, etc.





### Bonneville Release Site

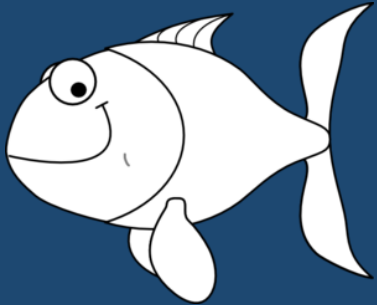
- 580 tagged smolts
- Held in flow-through tanks
- 20 GBT mortalities

### Warrendale Release Site

- 200 tagged smolts
- Transported by barge in gas-stripped tanks

# Estimating Effect Sizes

- Model survival for each group in each migratory segment, with a common detection parameter at each subarray
- Calculate daily survival as  $S^{1/T}$
- Bootstrap resampling for estimating standard errors
- Subtract low exposure survival from high for effect size



## Survival Rate (per day)

High Gas  
(>120%)

Low Gas  
(≤120%)

Effect  
Size

Bonneville  
Releases

River

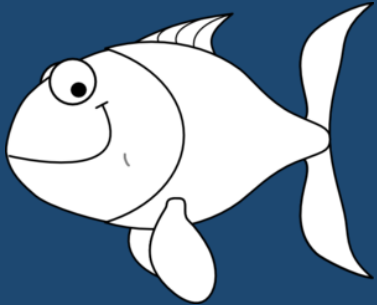
Plume

Warrendale  
Releases

River

Plume





## Survival Rate (per day)

High Gas  
(>120%)

Low Gas  
(≤120%)

Effect  
Size

Bonneville  
Releases

River

0.93 (.01)

0.99 (0.0)

-0.06 (.01)

Plume

0.74 (.05)

0.89 (.02)

-0.15(.05)

Warrendale  
Releases

River

0.96(.01)

0.95 (.01)

0.01(.02)

Plume

0.66 (.20)

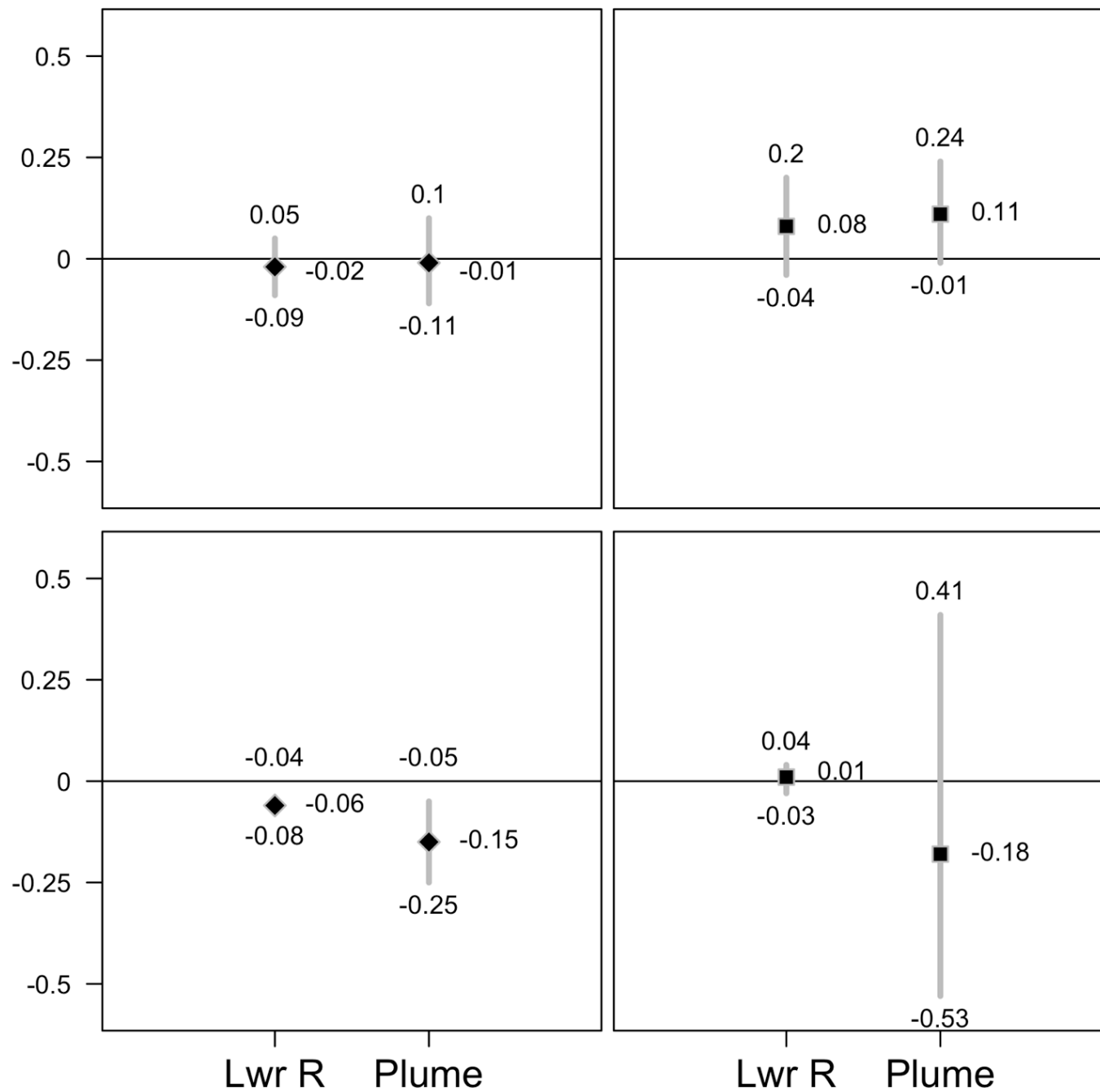
0.84(.12)

-0.18(.24)

Effect Size (Survival Rate) Effect Size (Survival)

In-river

Transport

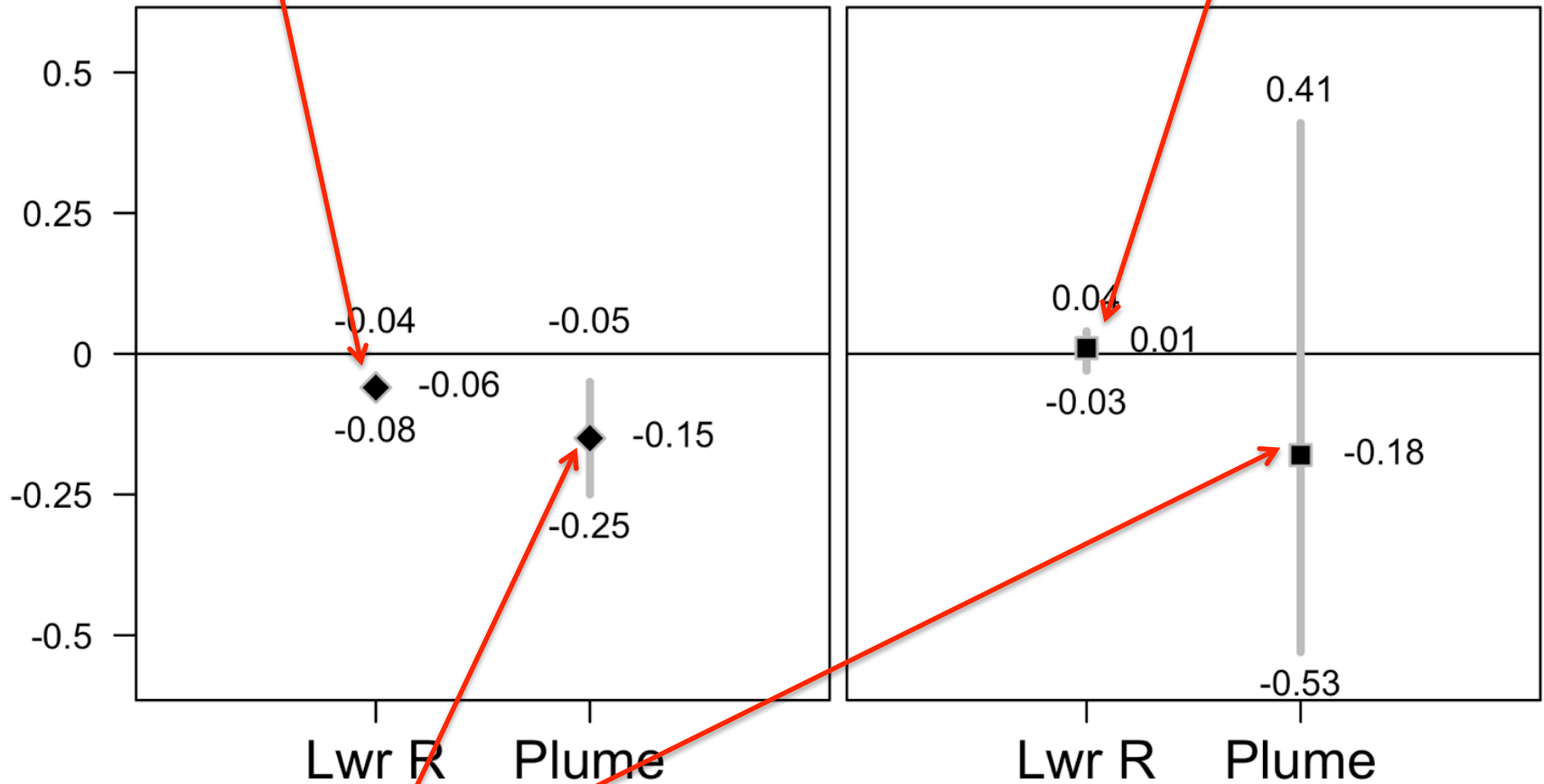




- Repeat exposure, flow through tank
- ~132% TDG, mortality w/ in hours

- Gas stripped barge
- ~125% TDG, Mortality in days
- Plume in 3 days

Effect Size (Survival Rate)



- Chronic effects expressed during habitat transition?
- Low survival relative to river
- Likely not the saltwater transition

# But wait, there's more...

- Temperature? 8- 13 C
- Turbidity? *Increases with TDG*
- Disease? *No significant change*

# Acknowledgements

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Questions?